E CIRCLE NEPHROSTOMY TUBE: AN ATTRACTIVE NEPHROSTOMY DRAINAGE SYSTEM FOLLOWING COMPLEX PERCUTANEOUS NEPHROLITHOTOMY

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Abstract

Objective: To describe our experience with the circle NT (Cook® Medical), a drainage system uniquely designed for use after multiple access PNL.

Materials and Methods: A retrospective review of 1317 consecutive patients undergoing 1599 PNLs at IU Health Methodist Hospital was performed. All multiple access cases utilizing circle NTs were reviewed and analyzed. The method of insertion of circle NT is demonstrated.

Results: A total of 1843 accesses were obtained in 1599 renal units RUs: 380 upper, 129 mid, and 1334 lower. Multiple accesses in this series were required in 282 RU (17.6%). Following multiple access PNL, circle NTs, cope loop, and re-entry Malecot NTs were inserted in 91 RU (32.3%), 208 RU (73.8%),

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and 31 RU (11%), respectively. The overall transfusion rate was 3.49%. None of the patients who had circle NT experienced clogging, dislodgement, or obstruction of the tube. The cost of circle, cope loop, and Malecot NTs are 121.73, 95.20, and 81 USDs, respectively.

Conclusion: Circle NTs are easy to insert, secure, cost effective compared to inserting two NTs. Circle NTs provide excellent drainage and facilitate secondary procedures.

Introduction

Percutaneous nephrolithotomy (PNL) is the preferred approach for managing large and complex kidney stones.[1] The percutaneous approach allows complete stone removal even in the largest of stones through one or more accesses and obviates open stone removal. The indications for PNL include conditions such as staghorn calculi, lower pole stones, calyceal diverticular calculi, ectopic kidneys with stones, failure of ureteroscopy or lithotripsy, or stone removal with planned concurrent procedures such as antegrade endopyelotomy. Multiple access is sometimes necessary to achieve complete stone clearance.[2]

Post procedural nephrostomy tube (NT) placement is generally recommended for drainage, as well as maintaining access in the event a secondary stone procedure is necessary. The choice of NT placement after PNL varies widely by provider[3–5] and there has been a recent trend to minimize NT use or abandoning it altogether.[6–8] However, a tubeless approach is applicable only in select straightforward cases[9] and not when multiple access tracts are made as such complex cases have a higher potential for morbidity, bleeding, obstruction, and need for secondary procedures.[10]

As previously reported by Kim et al, NTs available are cope loop, reentry Malecot catheters, Foley catheters, and circle NT.[2] At our institution, it is our custom to leave the smallest NT for a single puncture PNL and the circle NT for multiple access PNL. Despite perceived advantages in terms of security, drainage, comfort, and cost, there are few reports of the use of circle NT in the medical literature.[11] Herein we describe and demonstrate the use of the circle nephrostomy tube (Cook® Medical) following complex PNL.

Methods

After IRB approval, a retrospective review of 1317 consecutive patients who had 1599 PNL by multiple surgeons at IU Health Methodist Hospital from January 2003 to June 2014 was performed. Cases with renal units (RU) treated with multiple accesses were reviewed and analyzed. Demographic data, number and location of accesses, NTs used, and complications were recorded. All accesses were obtained by the urologist whereby access to the desired calyx is obtained using an 18-gauge diamond-tipped needle utilizing a fluoroscopic triangulation technique.[12] A Boston Scientific® Nephromax balloon is then used to dilate the tract and place a 30 F Amplatz sheath. Rigid nephroscopy is performed and an ultrasonic lithotrite is utilized for stone fragmentation. Once all stone material accessible to rigid instruments is removed, the flexible nephroscope is used to assess the remainder of the kidney. If a substantial amount of stone (>2 cm) remains in a location not otherwise accessible with rigid instruments, additional access is obtained. In cases needing only a single access, a 10 F cope loop NT and 5-French open-ended ureteral catheter are left down the ureter to help secure access.[13] Antegrade double-J ureteral stents are not used unless concomitant ureteric or ureteropelvic junction pathology is encountered.

A non-contrast CT scan is routinely obtained the morning after surgery to assess for any residual fragments or complications. If there are any residual stones, a secondary procedure is performed. Once deemed stone free, a nephrostogram is routinely performed to assess for adequate antegrade drainage. If the ureter is patent, the nephrostomy tube is removed.

Technique of insertion

In the case of multiple access PNL a circle NT (Cook® Medical) is commonly utilized. The circle NT consists of a silicone circle nephrostomy catheter, 30 cm polyvinyl chloride connecting tube and a Y connector. Circle NTs come in 4 different sizes, 14-20 F, and has two radio-opaque markers to facilitate proper positioning inside the kidney (Figure 1).

After obtaining additional access, a 0.035 zip wire is passed into the collecting system and identified by the flexible nephroscope. A 5 F flexible Wolf® grasper is utilized to pull the wire through the initial access (Figure 2A). Once thru and thru access is obtained, the zip wire is exchanged for a stiffer working wire. Dilatation and utilization of the additional access is performed as described above.

Prior to placement, the circle NT is prepared on the back table by inserting an 8 F coaxial dilator through its lumen (Figure 2B). This is faciitated if the circle NT is wetted first. The tube is then passed over the working wire from either direction (Figure 2C). Hemostats are placed on both ends of the wire at the end of the 8 F coaxial dilator to facilitate passing of the tube and a push- pull maneuver is then used to pass the tube from one point of access to the other. Once both ends of the tubes can be seen emerging from the skin, the Amplatz sheaths, working wire, and the coaxial dilator are removed (Figure 2D). The tube is then positioned within the kidney using the radio-opaque markers and fluoroscopic guidance. Contrast is injected to confirm proper positioning (Figure 3A, 3B). The silicon tubing is cut to the desired length and attached to the Y connector and the drainage bag (Figure 3C). The tube is then secured to the skin using 2-0 silk suture (Figure 3D).

Gaining access for a secondary procedure thru the circle NT

The two ends of the pre-placed circle NT are cut (Figure 4A) and a straight moveable core wire is advanced through one end of the NT while the other end is concomitantly pulled. Fluoroscopy is usually not required for this maneuver. Both access sites can then be utilized as needed (Figure 4B, 4C).

Results

Of the 1317 patients studied, a total of 1843 accesses were obtained in 1599 RUs; 380 upper, 129 mid, and 1334 lower pole. Multiple accesses were performed in 282 RU (17.6%) with a total of 573 additional accesses. Out of this additional accesses, 175, 66 and 332 accesses were placed in the upper, mid and lower pole, respectively.

Following multiple access PNL, every RU was left with at least one NT. A total of 330 NTs were placed in the additional 573 accesses. 70 NTs in the upper pole, 48 in the mid pole and 303 in the lower pole. Circle NTs, Cope Loop and re-entry Malecot catheter were placed in 91, 208 and 31 RUs, respectively. 84 patients with circle NTs required secondary percutaneous procedures. The average BMI in the circle NT cohort was 38.9.

The overall transfusion rate was 3.49% in multiple accesses cases compared to 2.5% in single access cases (p=1). The use of circle NT had no influence on the risk of hemorrhage. The post-operative hemoglobin was 10.9 for both circle NT and any other NT (p=0.9). No complications were attributed to the insertion of the circle NT. There was no difference in infections, complications, or readmission rates among the various NTs. None of these patients experienced clogging, dislodgement, or obstruction of the tube.

The cost of circle, cope loop, and reentry Malecot are 121.73 USD, 95.20 and 81 USD, respectively. Despite being more expensive than any other single NT, the circle NT is cheaper when considering placing a NT in each access.

Discussion

It is well accepted that PNL is the gold standard management for renal stones larger than 2 cm. The decision and choice to leave a NT after surgery, however, remains controversial.[1–6] Despite the innovation in terms of NT design over the years since the introduction of PNL in 1976,[14] very few publications have addressed NT selection post-operatively.[2,11]

We believe that the circle NT offers an optimal choice of drainage after multiple access PNL. Besides the demonstrated cost savings of using a singular drainage tube rather than combining two separate alternative NTs, we believe the circle NT has several other unique advantages as well.

There were no instances of tube dislodgment when this device was used. This is due to the through and through nature of the tube design whereby each end is secured externally creating a loop within the kidney. Tube security is an important factor to consider when choosing an appropriate NT as rates of dislodgment can be vary between (1-30%).[15,16] Bayne et al reported BMI as a sole determinant of nephrostomy tube dislodgment with a rate of 6%. However, the choice of his NTs were only Malecot, cope loop, and Foley without mentioning the circle NT as a secure option.[17]

Another benefit of the circle NT is that it is available in a variety of sizes. Large diameter NTs have been proven to cause more pain, discomfort, and need for analgesics.[7,8,18] As reported by Pietrow et al[7], Maheshwari et al[8], and Liatsikos et al[18], there is a relationship between the size of NT and pain. However, no circle NT was studied in these series. NT sizes have evolved from initial sizes of 24-28 F to smaller sized tubes 8.5-10 F.[2,6,10,19–21] The circle NT comes in sizes 14-20F and while these are slightly larger than some alternative NTs, we believe that the relatively larger size is sometimes necessary, especially for complicated cases where maximal drainage is warranted and secondary procedures are often needed. Furthermore, the soft silicon material of the circle NT differs from the traditional harder material of a cope loop and/or Malecot. While no formal pain assessments have been performed studying this to date, it is our anecdotal experience that patients rarely complain of significant discomfort when such tubes are utilized.

The tubeless PNL technique has gained popularity since its introduction in the late 1990s.[22] However, it should only be used in selected patients excluding patients with intraoperative bleeding, questionable residual stones, multiple access PNL, chronic kidney disease, and supracostal approaches.[23,24]

At our institution, in multiple access PNL, each RU gets at least one NT. For combined upper pole and either lower pole or mid-pole access, if complete stone clearance has been achieved, a 10 F cope loop is inserted thru one access while the upper pole access is left tubeless to minimize the pain from inserting the tube between the ribs. In our series, 105/175 (60%) upper pole accessed in multiple access cases have been left tubeless. The use of circle NT for multiple access PNL is performed if there is a possible need for a secondary procedure, risk of dislodgement of the tube especially in patients with high body mass index, or if there is unusual intraoperative bleeding that warrants maximal drainage. None of the patients who had circle NT experienced clogging or obstruction of the tube, likely due to the prescence of multiple side holes that allows maximal drainage.

Gaining access for a secondary procedure is easy and quick with the circle NT. Feeding a soft tip wire from one end to another is a simple, risk-free procedure, uses little or no flouroscopy, utilizes both tracts, and saves times when compared to gaining access thru multiple tubes.

This study is not devoid of limitations. It is retrospective in nature, although the data are collected in a prospective fashion in order to minimize bias. As this study spans a 12-year period, differences in patients, experience of surgeon and techniques may exist. Despite these limitations, this study is the first to focus on circle NT and the method of its insertion.

In summary, the circle NT offers a cost-effective, secure, and reliable method of drainage and reaccess after multiple access PNL.

Conclusion

Circle NTs are easy to insert as demonstrated, provide secure access, and optimal drainage. Circle NTs come in a variety of sizes (14-20 F), facilitate secondary procedures, and are cost effective when compared to inserting two cope loops or a re-entry Malecots.

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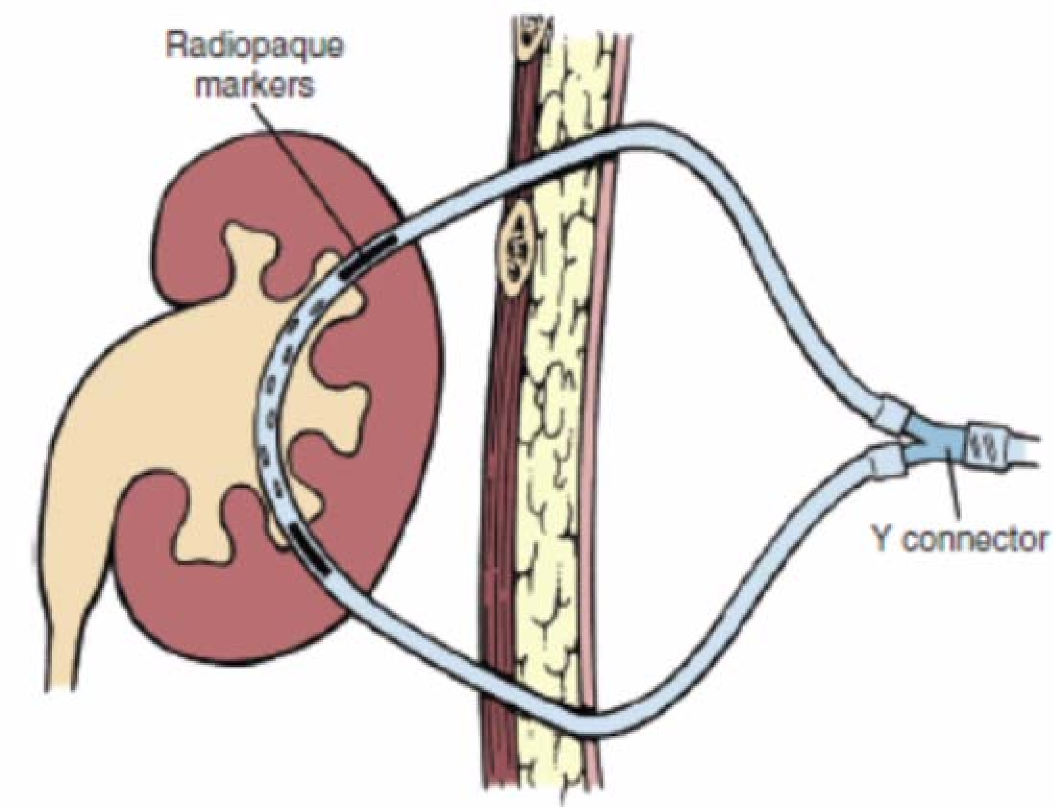
Figure 1: Circle NT (Campbell-Walsh Urology. 10^{th} ed. Philadelphia, Saunders [an imprint of Elsevier Science], Chapter 47, pg. 1344, 2012.)

Figure 2: A: Identifying the zip wire and gaining thru and thru access; B: Preparing the circle NT; C: Push and pull maneuver; D: Both ends of the tube through both access.

Figure 3: A: Injection of contrast material; B: Positioning of the NT within the kidney; C: Attaching the Y-connector to both ends of the tubes; D: securing the tube to the skin.

Figure 4: A: Preparing the NT for the secondary procedure by cutting both ends to the appropriate length; B: Soft tip wire is advanced thru one end of the tube; C: Push and pull maneuver until the wire is through and through.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